

THE WEATHER AND CIRCULATION OF SEPTEMBER 1970

Warm in the East and Cool in the West With Heavy Precipitation in Many Central Areas

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1. HIGHLIGHTS

Two weather-related phenomena highlighted the weather and circulation for September 1970. A critical power shortage occurred in the East as a late season heat wave caused heavy usage of air-conditioning equipment. Meanwhile, extremely dry southern California experienced a major fire disaster near the end of the month as Santa Ana winds fanned brush fires out of control causing at least 10 deaths and destruction of about 400 homes.

The hottest weather of the year enveloped parts of the East during September 22–26. Under a strong ridge aloft, daytime temperatures soared well into the 90s, producing many daily maximum records; and at Trenton, N.J., the thermometer registered 90°F or higher on 5 consecutive days for the first time in late September in over 100 yr. Electrical demands for air conditioning severely taxed the generating system throughout the East; but a large-scale “blackout” was avoided, and the critical period ended when a cold front brought relief on the 27th.

Forest fire danger in California increased throughout the month as dry conditions prevailed, a continuation of the normal summertime drought. Major fires began breaking out about the middle of the month, but the worst occurred later in southern California. Severe Santa Ana winds beginning on the 25th fanned brush fires out of control, particularly in San Diego and Los Angeles Counties, and brought a temperature of 105°F to Los Angeles on the 27th. The desert winds abated after the 28th, but some fires still burned at the end of the month.

2. MEAN CIRCULATION

The mean 700-mb circulation for September 1970 (figs. 1 and 2) featured blocking over northern Asia, a short wavelength pattern over the Pacific Ocean, and an extremely fast zonal flow from eastern North America to England. The circulation over the United States with a trough over the West and a ridge in the East represented a change of the trough-ridge pattern from that of the past 2 mo (Stark 1970).

Cyclonic flow covered much of North America as a deep Low became established over Davis Strait. This Low and the western trough were accompanied by below-normal heights over most of the continent, except for the eastern United States and Alaska. The introduction of cyclonic conditions to the West brought height falls of up to 50 m there, while rises of 40 m occurred with the ridge over the East (fig. 3). The mid-latitude westerlies over eastern North America and the Atlantic were stronger than normal, and the jet axis was displaced south of its usual position

(fig. 4). Maximum wind speeds were 18 m sec^{-1} in the Atlantic, about 8 m sec^{-1} above normal.

A ridge was observed over Europe with positive height anomalies of up to 60 m in southern France. The ridge was weaker than normal in Scandinavia, however, as height falls of 80 m resulted when the positive anomaly associated with the August ridge moved eastward. The jet axis remained well south of normal over Europe and extreme western Asia, while the jet normally observed in the Mediterranean area was ill-defined.

The height anomaly pattern over Asia reversed from the previous month as height rises of up to 130 m occurred over northern Asia with falls to the south. The rises were associated with the development of a strong blocking High over Siberia and the eastward progression of the ridge that had been over Scandinavia. Height departures for the month were up to 90 m above normal in an area that had been below normal in August.

A Low developed in the Sea of Okhotsk, while downstream deepening occurred south of the Aleutians in the northerly flow east of the Siberian High. The sharp trough over the central Pacific, which was weakly connected across Alaska to a polar Low, helped to maintain a ridge over the eastern Pacific.

3. TEMPERATURE

Mean surface temperatures for September 1970 averaged lower than normal in the West, except for coastal California, and higher than normal in the East (fig. 5), corresponding well with the 700-mb circulation and its anomaly (figs. 1 and 2). Parts of the Northwest and northern and central Rocky Mountain States averaged more than 6°F below normal, in sharp contrast to the high anomalies of August. Temperatures were unusually low in the Northwest as Pendleton, Oreg., experienced the coldest September on record with a mean of 56.3°F, an anomaly of -7.9°F , and Walla Walla, Wash., with a 60.4°F average was the lowest since 1926. Many stations reported new daily low-temperature records during the month; and Missoula, Mont., had its lowest average September minimum with 35.4°F. Below-normal temperatures extended southward to the Mexican border as several cool Highs pushed abnormally far southward during the month.

In the warm East, temperatures were more than 3°F above the normal from the lower Mississippi Valley northeastward to the Middle Atlantic States. It was the warmest September since at least the early 1930s at Richmond, Va. (74.8°F), Parkersburg, W. Va. (71.9°F),

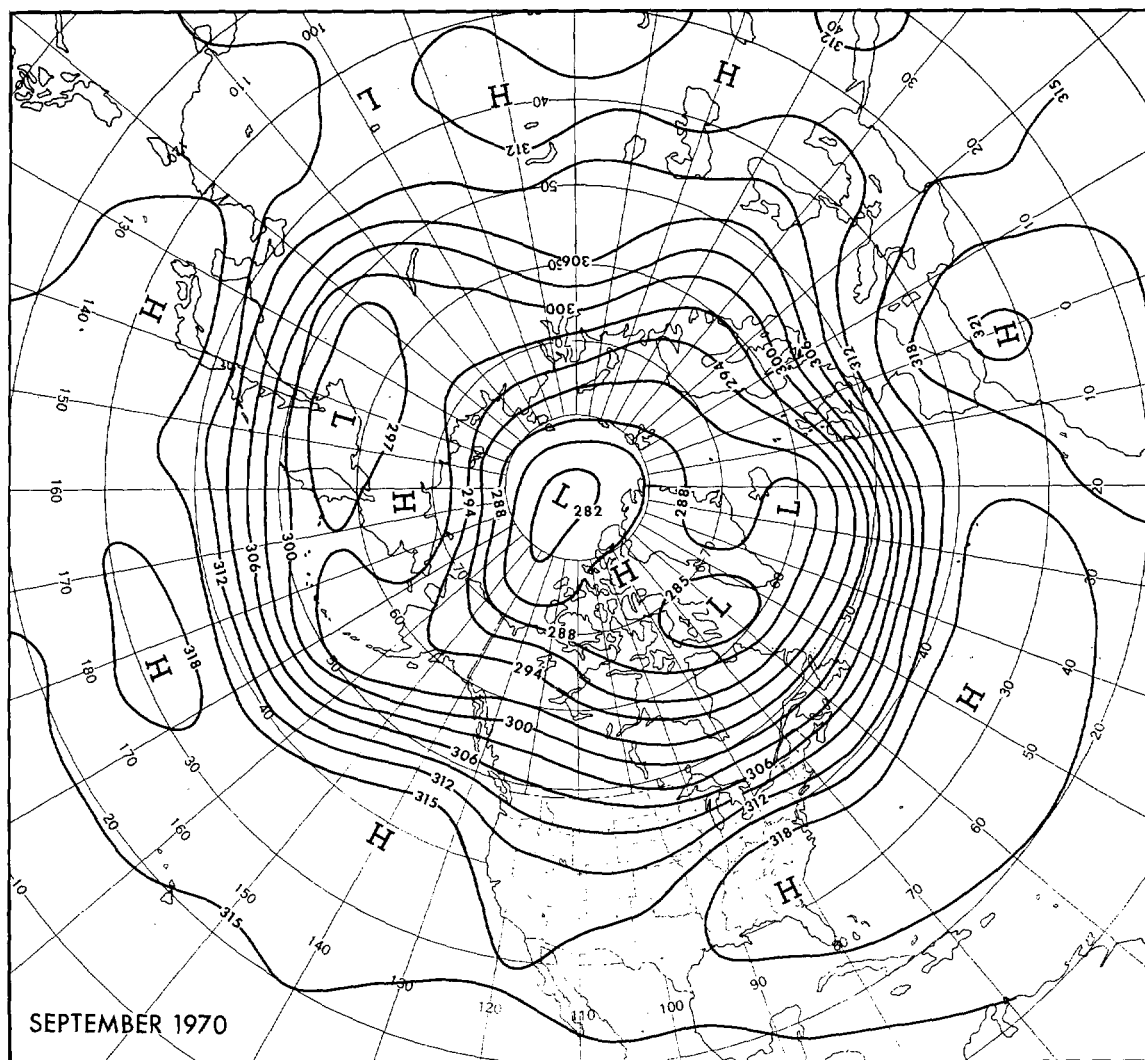


FIGURE 1.—Mean 700-mb contours (decameters) for September 1970.

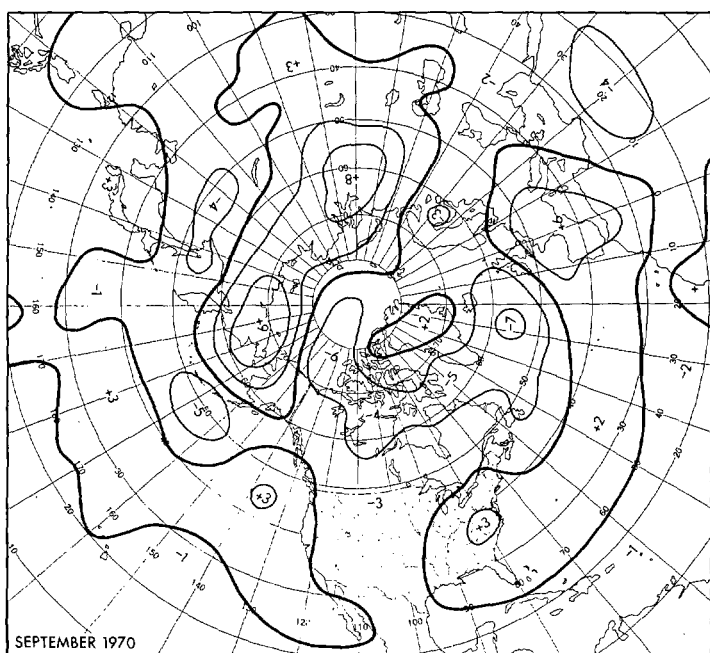


FIGURE 2.—Departure from normal of mean 700-mb height (decameters) for September 1970.

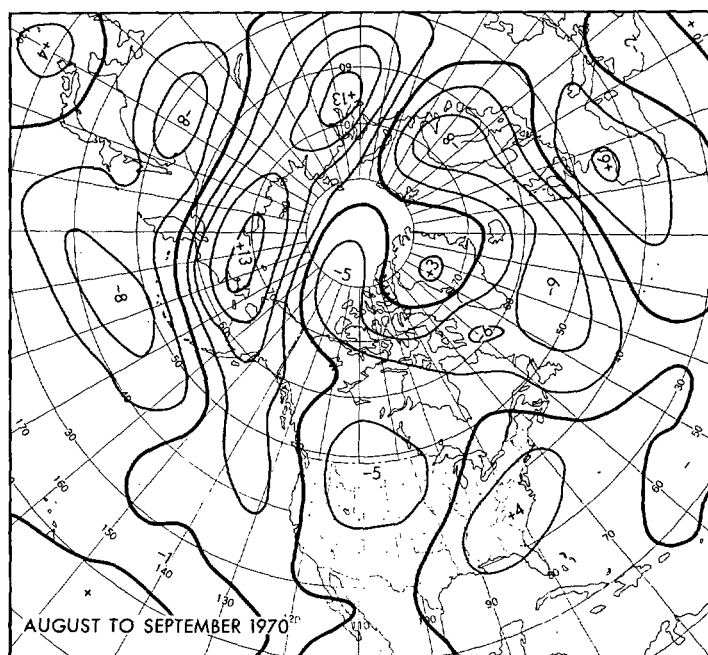


FIGURE 3.—Mean 700-mb height anomaly change (decameters) from August to September 1970.

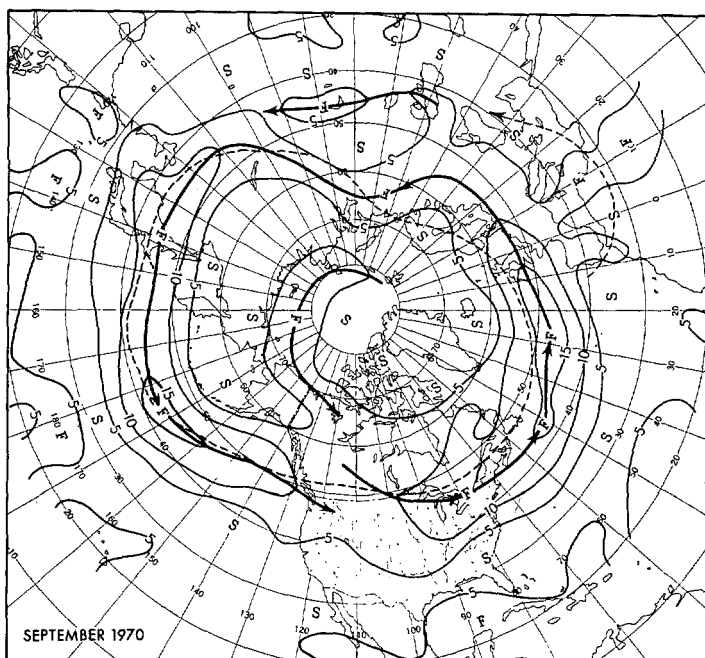


FIGURE 4.—Mean 700-mb isotachs (meters per second) for September 1970. Heavy lines indicate principal axes of maximum wind speed; dashed lines, the normal.

Columbia, S.C. (78.6°F), Lynchburg, Va. (73.1°F), and Pensacola, Fla. (82.2°F).

4. PRECIPITATION

Precipitation of more than twice the normal amount fell in a broad band from Texas to Michigan (fig. 6), with totals in excess of 8 in. occurring over a fairly large area from Oklahoma to Wisconsin. The maximum amount reported was 14.18 in. at Moline, Ill., where this was the heaviest precipitation for any month dating back to the beginning of station records in 1926. The 9.87 in. received at Springfield, Mo., was a September record, while it was the second wettest of record at Sault Ste. Marie, Mich. (7.78 in.), Oklahoma City, Okla. (9.64 in.), and Rockford, Ill. (10.63 in.). Much of the heavy precipitation along the boundary of the warm and cool air was produced as slowly moving cold fronts tapped the warm moisture-laden air brought northward from the Gulf of Mexico by stronger than normal southerly winds at 700 mb. Portions of the Rocky Mountain States also reported more than twice the normal precipitation with Salt Lake City, Utah, recording 2.80 in., the greatest September total since at least 1900.

In contrast, less than half the usual amounts were observed beneath the ridge in the East from Alabama and Florida to New Jersey. Likewise, much of the Far Southwest was abnormally dry under the northwesterly flow aloft, and most of California received no rain at all. The Federal Office Station at San Francisco had 94 percent of possible sunshine, the most in 80 yr of record.

Unusually strong northwesterly winds at 700 mb were associated with below-normal temperatures and light precipitation over most of Alaska. Temperatures ranged from 1° to 7°F below normal, while only stations in the

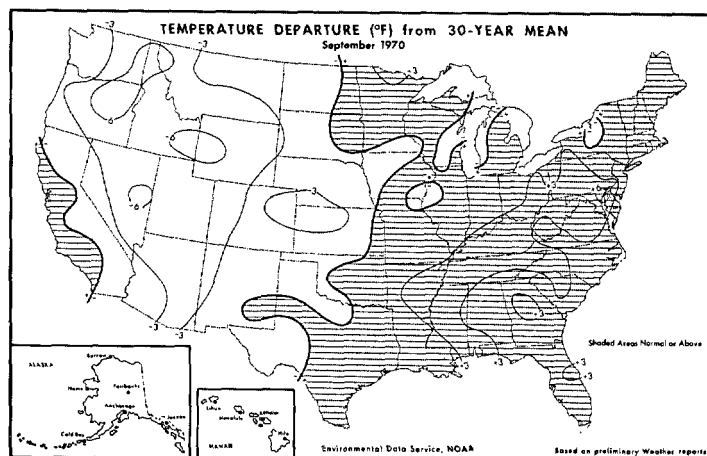


FIGURE 5.—Departure from normal of average surface temperature (°F) for September 1970 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service 1970).

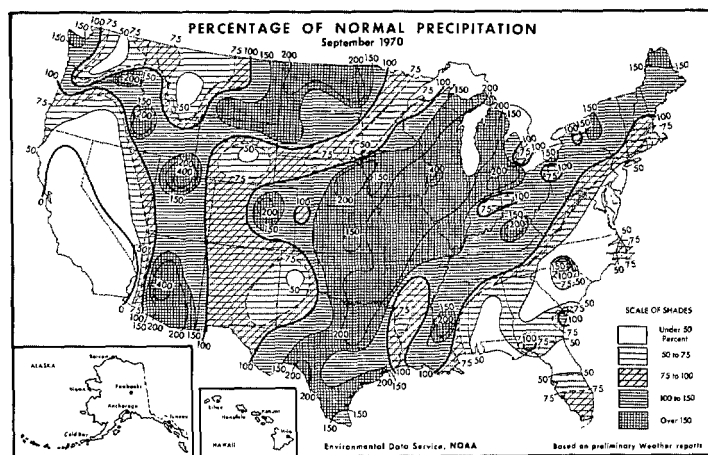


FIGURE 6.—Percentage of normal precipitation for September 1970 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service 1970).

extreme southern extremities of the State received above-normal precipitation.

5. WEEKLY WEATHER AND CIRCULATION

AUGUST 31–SEPTEMBER 6

The trend toward lower than normal temperatures in the West began early in the month as a trough became established over the Far West, bringing below-normal temperatures from the Pacific Coast States into the Great Basin (figs. 7A and 7B). Lower than normal values were also recorded over most of the Northeast in response to a trough off the east coast. Elsewhere, above-normal temperatures were the rule beneath the ridge that extended from the Southeast to the upper Mississippi Valley. Greatest departures were in the northern plains where Huron, S. Dak., equaled the record high for September of 106°F on the 6th.

Precipitation was observed over most of the Nation except for almost all of California and parts of the Dakotas (fig. 7C). More than 2 in. of rain was observed in an area from eastern Texas to Missouri where heavy rains of

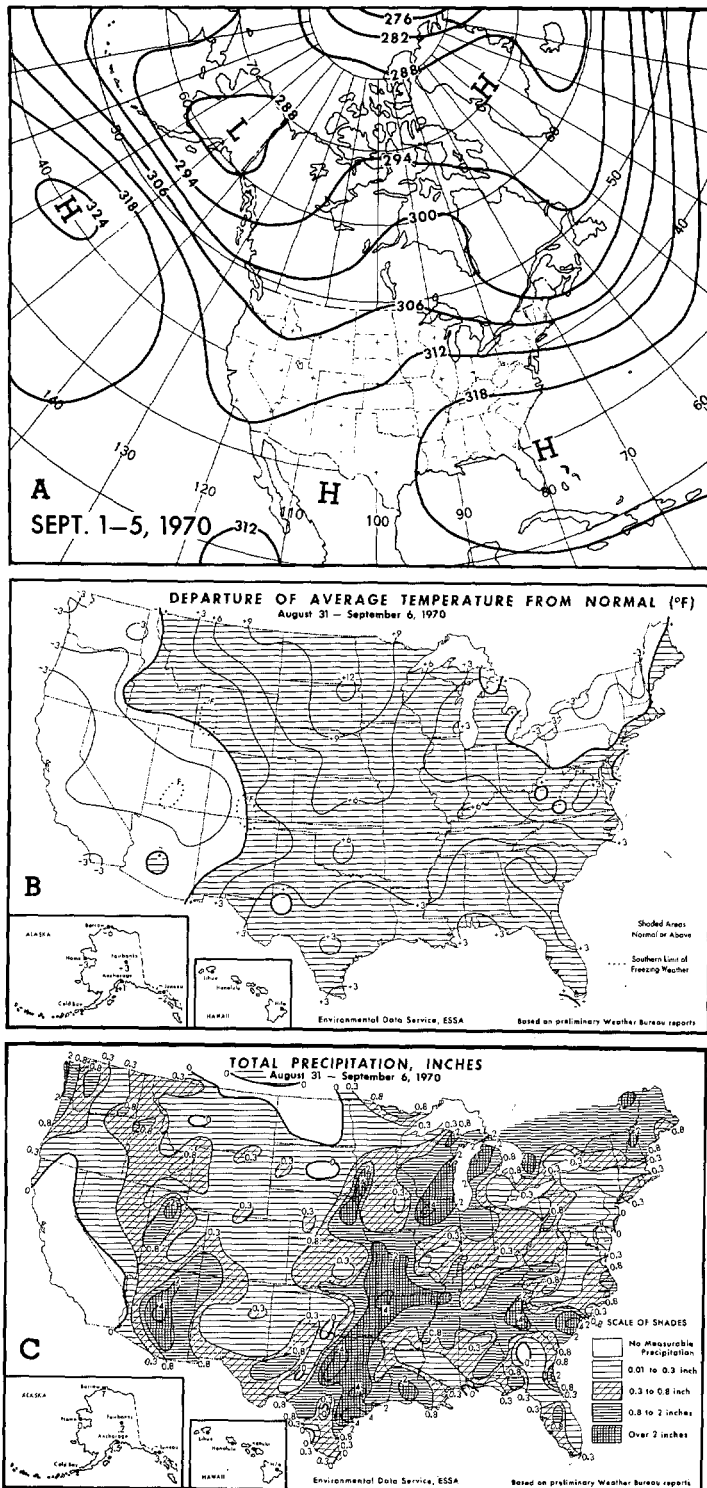


FIGURE 7.—(A) mean 700-mb contours (decimeters) for Sept. 1-5, 1970; (B) departure from normal of average surface temperature (°F) and (C) total precipitation (inches) for Aug. 31-Sept. 6, 1970 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service 1970).

up to 7 in. fell in the warm, moist southerly flow to the west of the 700-mb High. Scattered showers and thunderstorms totaled more than 4 in. of rain in Iowa and Illinois as well as Georgia and South Carolina.

At Milford, Utah, a frontal passage on the 5th dropped 1.33 in. of precipitation in 24 hr, a new September record. This was the only precipitation at Milford during the month.

Mountainous areas of central Arizona were hit hard near the end of the week as moisture advected from the area of Pacific tropical storm Norma resulted in heavy orographic rains with much flooding. Maximum amounts ranged from about 5 to 8 in., with 7.01 in. falling at Crown King in a 24-hr period ending on the 5th.

SEPTEMBER 7-13

Development of a strong ridge in the Gulf of Alaska and a deep Low over eastern Canada brought below-normal temperatures to the previously quite warm northern plains and into the western Great Lakes region (figs. 8A and 8B). Meanwhile, temperatures increased in the Far Southwest and much of the Northeast to produce lower than normal anomalies from California through the South and over most of the East as a weak ridge remained entrenched there. The main exception was a strip of below-normal temperatures along the Atlantic coast from Maine to the Carolinas.

A strong polar outbreak after midweek brought sub-freezing temperatures to the northern and central Rockies and the northern plains, setting numerous daily minimum temperature records on the 13th. The 27°F reading at Olympia, Wash., was a new low-temperature record for September.

The area of no precipitation in California expanded this period to include all of Nevada and parts of surrounding States, while three frontal passages brought rains of more than 2 in. to the middle Mississippi Valley (fig. 8C). Isolated areas of 2 in. or more were observed in the South and East due mainly to frontal associated thunderstorm activity while the fringes of hurricane Ella caused rains in southern Texas. Snow came to the northern Rockies when the first major winter storm of the season swept the area late in the week, with 14 in. reported in the mountains of Wyoming.

SEPTEMBER 14-20

The circulation over the eastern Pacific flattened considerably from that of the previous week, culminating in a negatively tilted mean trough from the Gulf of Alaska to the west coast (fig. 9A). Downstream, the ridge over the East strengthened, creating a strong jet to the north over New England. The associated surface-temperature pattern consisted of below-normal values over the West, the North Central States, and the Northeast, with above-normal temperatures elsewhere (fig. 9B).

Below-normal temperatures over much of the West were primarily attributable to a strong cold air outbreak from the week before. Several stations reported new daily minimum records for the 14th, while Missoula, Mont., and Boise, Idaho, with 20° and 23°F, respectively, recorded the lowest September temperatures since 1926. The negative departures observed from the upper Mississippi Valley through the Northeast were associated with relatively heavy precipitation that occurred in confluent flow around the 700-mb ridge. Surface temperatures increased under the ridge as an area of more than +6°F departure was observed from Arkansas to New Jersey.

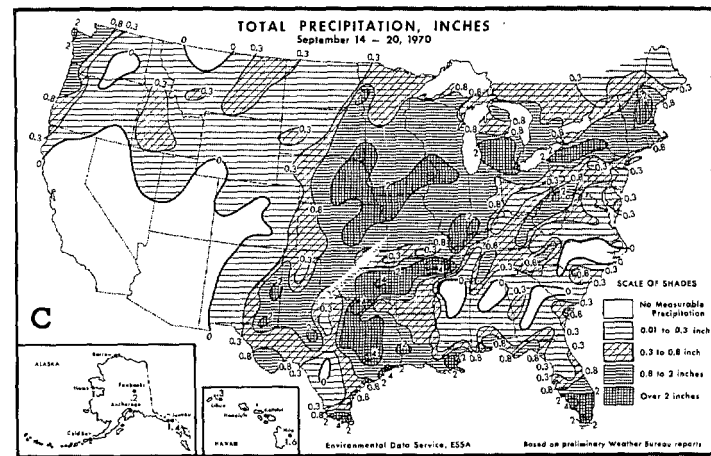
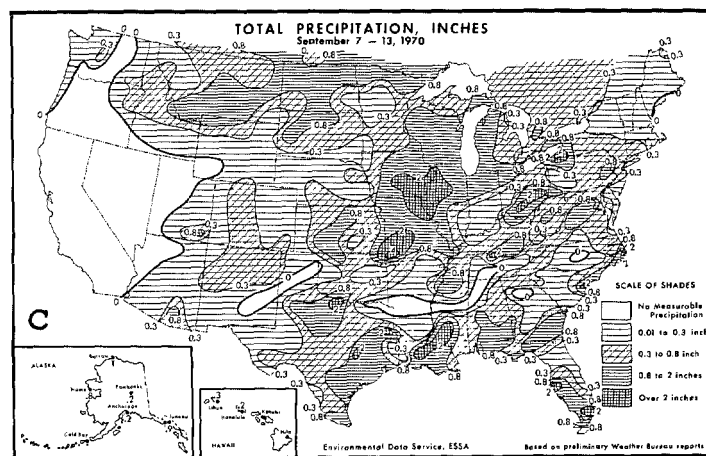
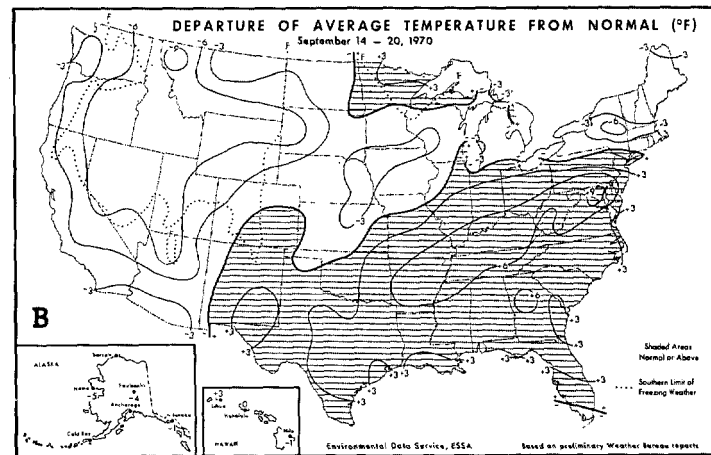
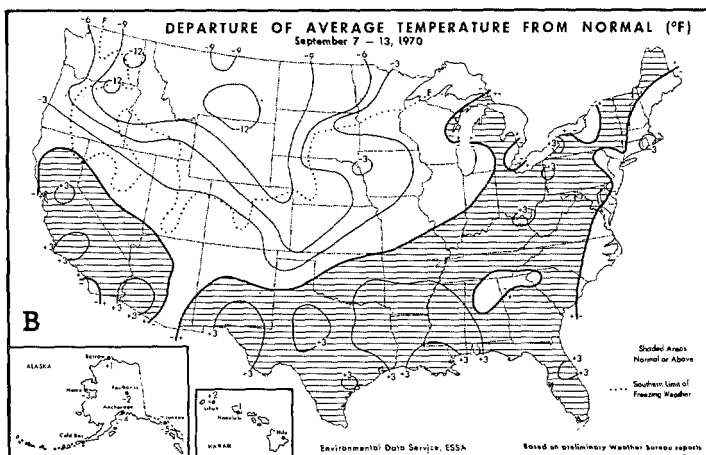
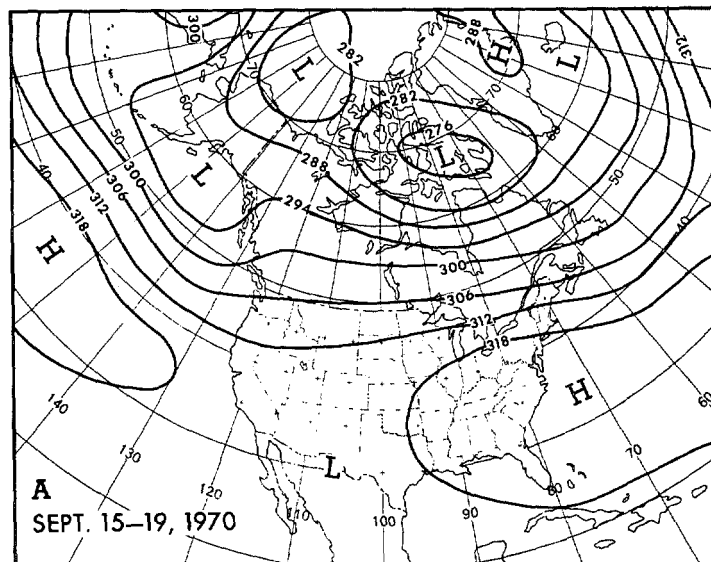
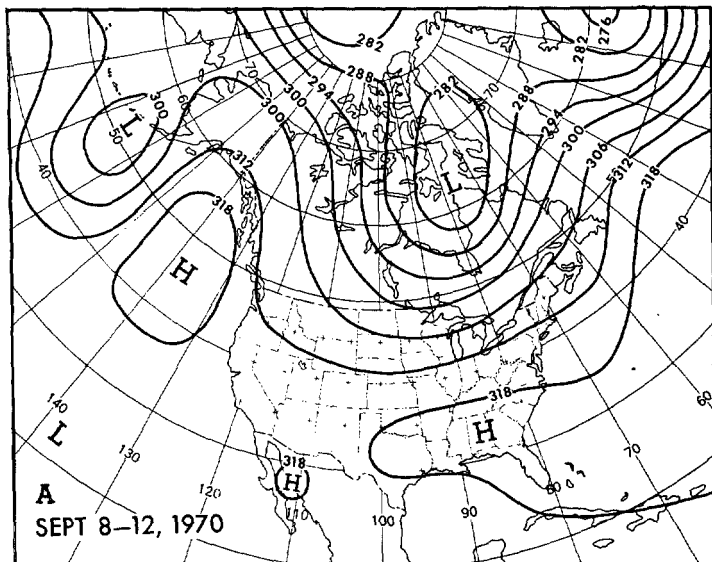


FIGURE 8.—Same as figure 7, (A) for Sept. 8-12, 1970; (B) and (C) for Sept. 7-13, 1970 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service 1970).

FIGURE 9.—Same as figure 7, (A) for Sept. 15-19, 1970; (B) and (C) for Sept. 14-20, 1970 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service 1970).

No precipitation fell in most of the Far Southwest as well as in isolated spots of the Southeast (fig. 9C). Amounts of more than 2 in. were recorded in several areas from the central plains eastward to Maine. This rainfall was primarily the result of fronts lingering in the confluent zone north of the ridge. Heavy amounts from Louisiana through eastern Texas to western Tennessee were produced by hurricane Ella and its extratropical remnant. Tropical activity also contributed to heavy rains over southern Florida early in the week.

SEPTEMBER 21-27

Amplification of the 700-mb circulation took place this week as the West Coast trough moved into the Great Plains and deepened; the eastern ridge progressed slightly but remained strong, and another ridge appeared off the west coast (fig. 10A). Hot, dry weather invaded the East under the ridge as the hottest weather of the year was reported in parts of the Northeast where average temperature anomalies were up to 15°F above normal for the week (fig. 10B). For the period Septem-

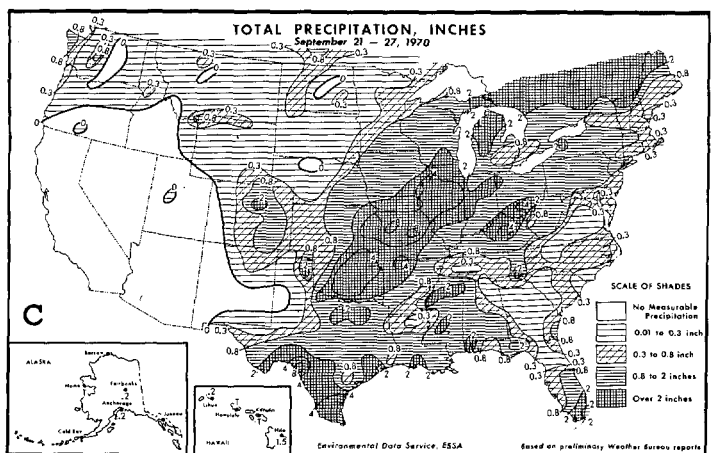
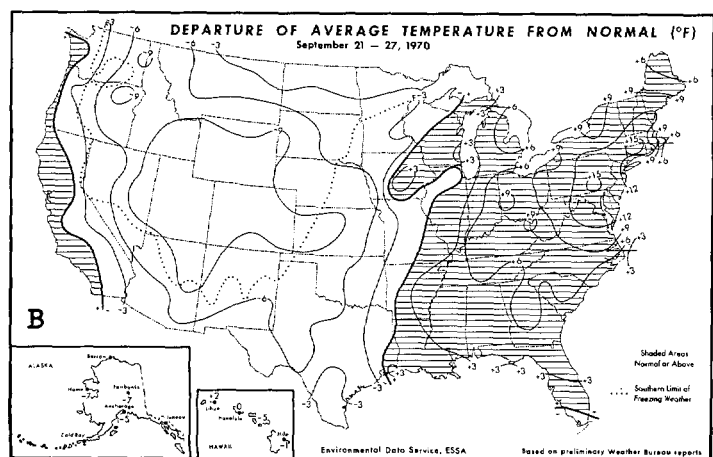
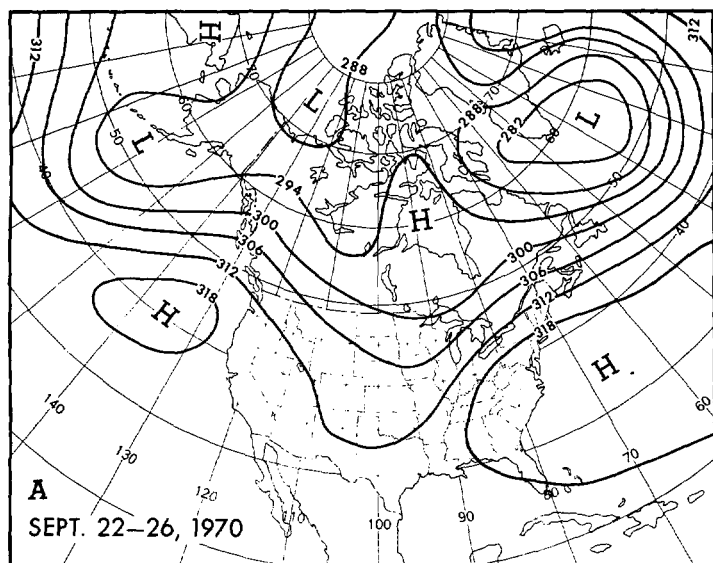


FIGURE 10.—Same as figure 7, (A) for Sept. 22-26, 1970; (B) and (C) for Sept. 21-27, 1970 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service 1970).

ber 22-26, the temperature at Philadelphia, Pa., averaged 18.6°F above normal, while maximum temperatures at Friendship Airport near Baltimore, Md., were 97°, 98°, 95°, 97°, and 95°F. Daily maximum records were equaled or set at many stations in the East during this period, but the heat wave was finally broken by a cold front with showers and thunderstorms on the 27th.

Temperatures in the West averaged above normal along the Pacific coast and below normal eastward to the

Mississippi River. Much of the Great Basin, the central Rockies, and western plains averaged 9° to 11°F lower than normal under the northwesterly flow aloft.

Precipitation of 2 in. or more fell in a band from southern Texas to Michigan and in parts of the Ohio Valley (fig. 10C). The bulk of this precipitation was connected with a wave development on a slowly moving cold front early in the week with 7.93 in. falling at Stroud, Okla., in a 24-hr period ending on the 23d. A cold front later in the week left 10 in. of snow at Fraser, Colo., and brought still more rain to the Mississippi Valley. Again, no precipitation was observed over much of the Southwest.

During the last few days of the month, the trough over the central United States moved eastward bringing below-normal temperatures to the East while positive anomalies came to the West as the ridge moved inland. Most of the Nation had bright sunny skies as a large surface High spread over the country.

6. TROPICAL ACTIVITY

Tropical activity affecting the coastal regions of the United States in September was limited to one hurricane, three tropical storms, and several weak disturbances with none causing any casualties or significant damage.

Ella became a hurricane north of Yucatan on the 10th; and after threatening the Texas coast, it ultimately moved westward making landfall on Mexico's northeast coast where 120 homes were destroyed as winds were clocked at 145 mi hr⁻¹. Some severe thunderstorms occurred in southern Texas, and Brownsville recorded maximum gusts of 30 mi hr⁻¹ as Ella passed well to the south.

A tropical disturbance moved into the Gulf of Mexico south of the Florida Keys on the 13th, bringing rain to the southern part of the State. By the next day, tropical storm Felice had formed and was moving toward the western part of the gulf coast. Felice remained poorly organized; and when it reached land near High Island, Tex., on the 15th, the highest gusts were only 55 mi hr⁻¹ at Galveston where 6.52 in. of rain fell. Heavy rains also occurred inland as the storm became extratropical. On the same day, a depression near Florida's west coast brought wind gusts of 58 mi hr⁻¹ to Fort Myers and more than 4 in. of rain to Naples.

Weakening tropical storm Greta moved westward across Key West, Fla., on the 27th, setting off heavy showers in the Keys and along the southeastern coast of the State. The storm had lost its identity over the Gulf of Mexico by the end of the month.

REFERENCES

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- Stark, L. P., "The Weather and Circulation of August 1970—Typical Summer Heat Associated With a Flat, Persistent Upper Level Flow," *Monthly Weather Review*, Vol. 98, No. 11, Nov. 1970, pp. 869-874.